

OCEAN WAVES NEAR HURRICANE JOSEPHINE FROM SIR-B

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Radar images of ocean surface waves near hurricane Josephine were acquired with the Shuttle Imaging Radar-B (SIR-B) system on October 12, 1984. Analyses of the directional ocean wave spectra derived from the imagery have been performed along most of the 600 km image track. These data reveal the presence of at least two dominant wave systems which undergo significant spatial variations in wavelength and direction.

Both satellite and airborne imaging radar systems, with their ability to penetrate clouds and produce high resolution data, have been used to study surface wave fields generated by hurricanes, the most complex condition for wave generation studies due to the rapidly changing and curving wind fields (The SWAMP Group, 1985; Elachi et al., 1977; McLeish and Ross, 1983; Gonzalez et al., 1982). These studies confirmed that the surface waves with the longest wavelength were generated near the area of maximum winds, the right rear quadrant, of the moving hurricanes. The rare opportunities to obtain synoptic observations of the wavenumber vector field near hurricanes such as provided by imaging radars are particularly valuable and can also be used, for example, as test cases for intercomparison studies for wave prediction models (The SWAMP Group, 1985).

Imaging radar data were acquired near hurricane Josephine from 16:31 to 16:33 GMT on October 12, 1984 (orbit 117). The resultant radar swath lay ahead and to the east of the hurricane at an approximate 45° angle to the storm track, with the closest approach at about 16:31:40 GMT at a point located about 90 km northeast of the hurricane center (Figure 1). The SIR-B data was obtained during the period of maximum hurricane intensity when the peak wind values were 90 knots.

The radar imagery revealed the presence of at least two dominant wave systems. The dominant wave system was detectable along the entire radar swath propagating north and northeast away from the storm track with a fan-shaped directional distribution. Secondary wave systems were detected which appear to be roughly aligned in the direction of the local cyclonic wind and propagating northwest and west in the upper portion of the radar track. These waves decrease in wavelength from north to south, disappear altogether at a point nearest the hurricane center, and then reappear in the southernmost portion of the radar imagery propagating east. This lack of signal in a portion of the imagery does not appear to be related to either azimuth-falloff or to limitations imposed by the finite resolution of SIR-B; rather, it may accurately reflect the chaotic nature of the winds and waves and the lack of a fully developed sea in the region nearest the hurricane.

Further analysis will include developing kinematic and dynamic models to study the wave characteristics. The kinematic model will determine the source regions for the evolving waves based on accurate measurements of wavelength, wave direction, timing, and hurricane position. The dynamic model will incorporate waveheight and observed gradients in wavelength and direction plus energy considerations to study waveheight as a function of time, radial spreading, and dissipation.

REFERENCES

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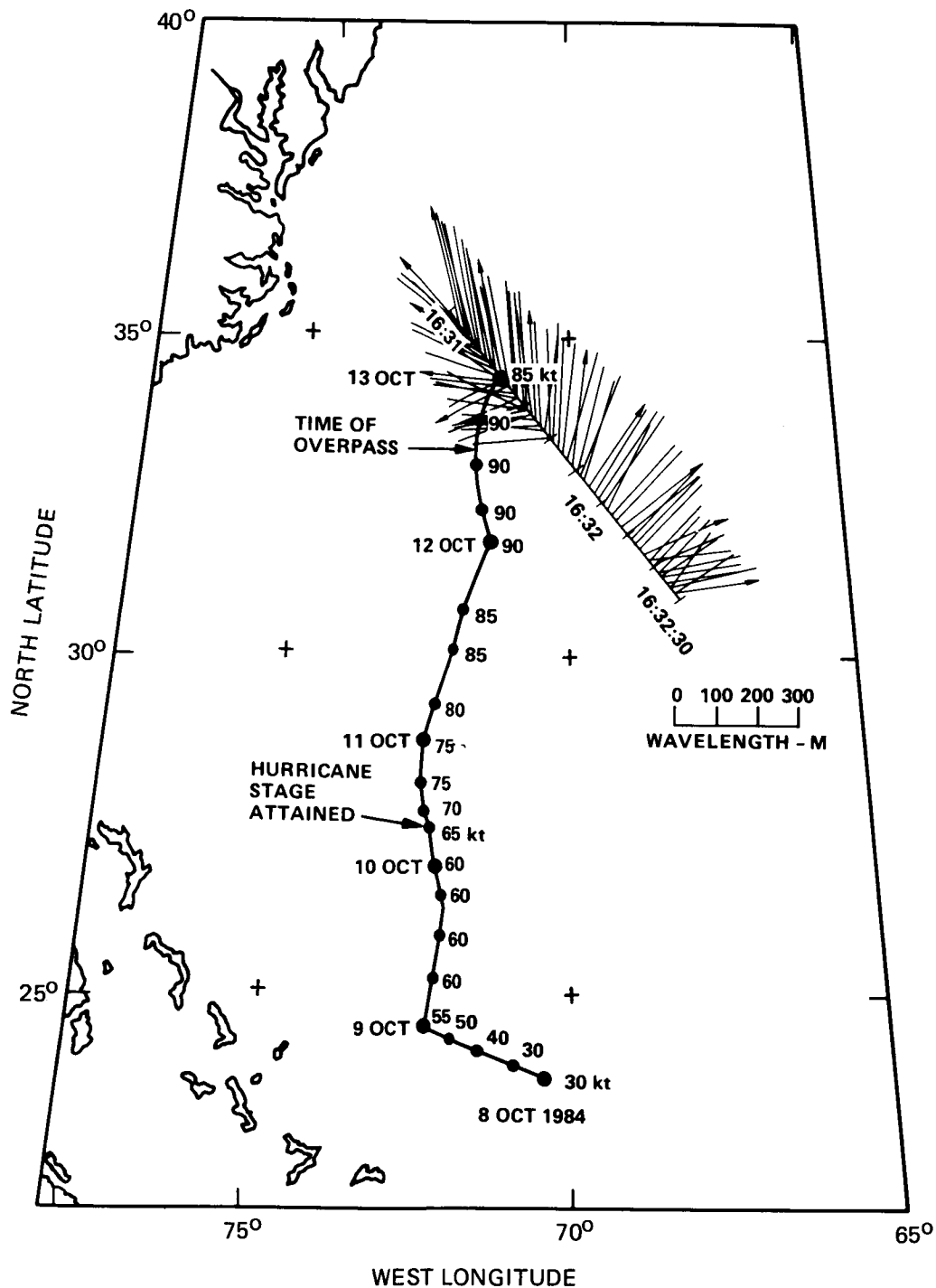
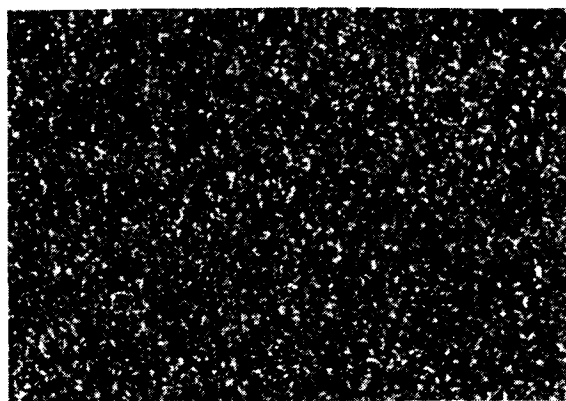
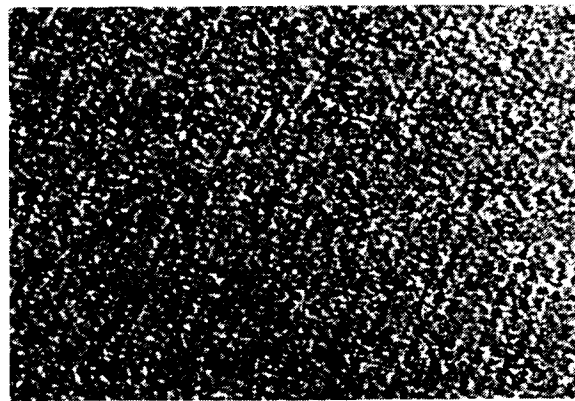


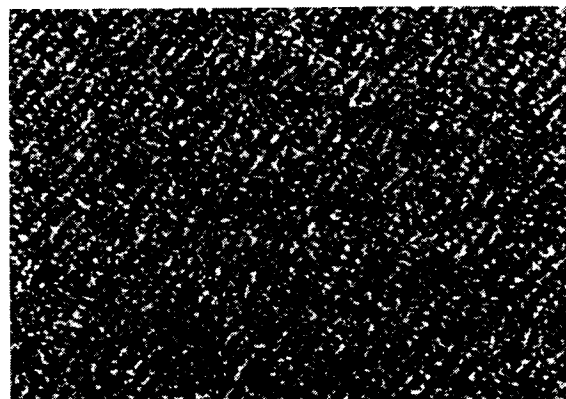
Figure 1. Map of partial track of hurricane Josephine (October 8-13, 1984) with maximum wind speeds in knots indicated for the storm center at 6-h intervals, track of SIR-B radar imagery (October 12, 1984) with times of acquisition indicated. Wavelength and direction of dominant wave systems are displayed along radar track. Arrows indicate general propagation direction of neighboring waves.



16:31:10



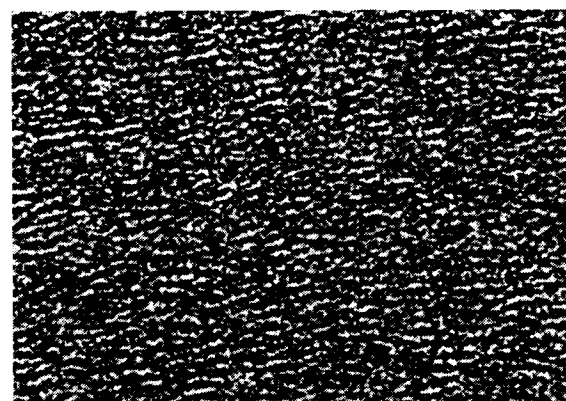
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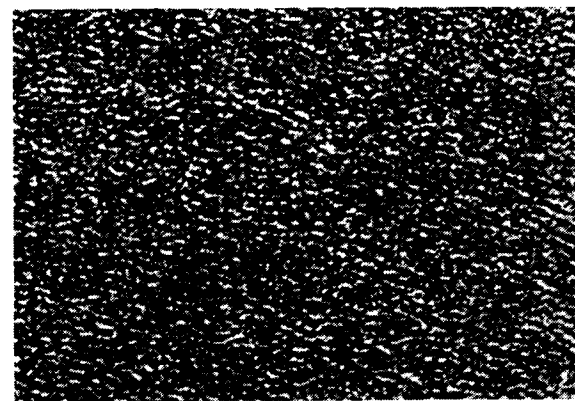
16:31:40



16:31:55



16:32:10



16:32:25

5 km

FLIGHT DIRECTION →
ILLUMINATION ↓

↖ N

Figure 2. Enlargements of SIR-B radar imagery of surface waves near hurricane Josephine (Data take 117.4). Each image covers an area 7 x 10 km in size and is centered in the radar swath at the time (GMT) indicated.